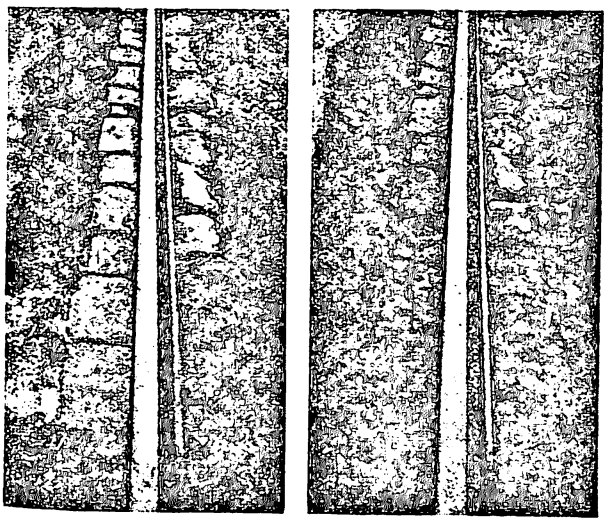
Reconditioning Provincial Tramways

Improvements Effected at Ballarat and Bendigo, Vic.

FOR many years the electric tramways in Ballarat and Bendigo, Vic., were operated by the Electric Supply Company of Victoria Ltd., the Bendigo system being inaugurated in 1903 and the Ballarat system in 1905. As the period of the company's franchises drew to a close the State Electricity Commission of Victoria arranged to take over its electricity supply undertakings in the two cities, but the question of future control of the tramways became a matter of some controversy. The operation of tramways in cities of such size (population approximately 40,000)



a b

Fig. 1. Typical Rail:
(a) Before Grinding; (b) After Grinding

had proved uneconomical, and the tracks and rolling stock had fallen into a state of poor repair owing to lack of adequate funds for maintenance. Finally, at the request of the respective city councils the Electricity Commission agreed to take over and operate the tramways as well as the electricity supply.

Immediate attention was given to the task of reconstructing tracks, placing overhead work in safer condition, and bringing the rolling stock up to a better standard of efficiency. At the same time the respective municipalities took advantage of the work of reconditioning to improve the condition of the roadways. Drainage has been improved, tracks moved to more suitable positions, centre poles removed and span poles substituted. Rail levels have also been altered to permit of satisfactory road regrading. In Bendigo the Mitchell street railway bridge has been widened, thus providing a safe roadway for vehicular traffic in either direction along the route of tramways. In McCrae street where the tracks were originally laid at 9-ft. centres, they have been opened out to 10-ft. in order to give the required clearance between trams which were purchased from the Melbourne and metropolitan tramways board. In order to meet the wishes of the council, the track was moved to the centre of the roadway in High street, the distances involved varying from 4 ft. to a maximum of 7 ft. 10 in. The improvements effected in this street by the removal of the centre poles, re-location of track and loop positions, also the installation of an extra loop, have been favourably commented upon by

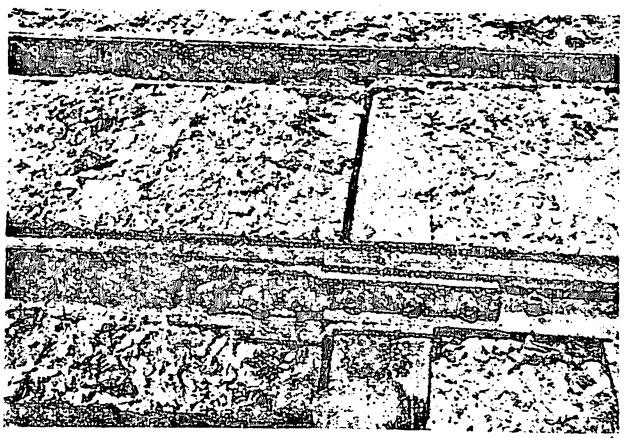


Fig. 2. Joggle Fishplates

the public, as has also the improved running schedule which eliminates undue waiting at the loops and at the Golden Square terminus.

In Ballarat conditions were such that it was found necessary to make much alteration to the track in order to allow for through routing. At present all routes terminate on the single track in Sturt street at Grenville street. This arrangement is not economical, and in many ways is unsatisfactory both from the public and commission's viewpoint.

Originally the rails were laid in both cities on longitudinal concrete stringers of varying width and depth, the average being approximately 24 in. and 9 in. respectively. These stringers were found to be badly fractured in many places owing to the subsidence of the foundations and the corrugated condition of the rails. Although the fish-plates were loose and many of them greatly worn, the rail ends were not as badly "hammered" as might be expected, as Askham sole plates had been placed under the joints and bolted to the rail flanges during construction. It can be stated with confidence that had electric welding been in vogue in these early days, and these sole plates welded to the rails in the first instance, very little trouble would have been experienced with the joints.

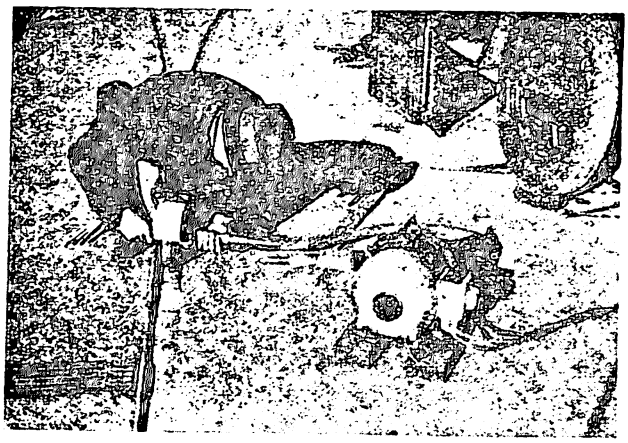


Fig. 3. Grinding Electrically-welded Rail Tread

Different methods of reconditioning were carefully considered, and the form decided upon was that which would keep costs within reasonable limits, having regard to the light traffic to be dealt with, and give reasonably satisfactory service for a number of years with a limited amount of maintenance expenditure. In addition to technical difficulties which had to be overcome, finance was an important factor and this was arranged in the following manner:—The government found £50,000, the State Electricity Commission £20,000 and the employment council £100,000, which after two years will bear interest at the rate of 4 per cent. It is gratifying to state that the work is being carried out with scarcely any interruption to the tram running schedule, and, with the exception of the replacement of some of the special work, it has all been carried out in the daytime.

A commencement was made with track reconditioning in Bendigo on October 9, 1934, and in Ballarat on November 20 of the same year. Before this, however, the overhead work received attention; badly worn trolley wire and fittings were replaced with new material, poles and scroll work painted and a number of improvements effected. At the date of writing, most of the trolley wire in the two cities has been renewed, and represents a total length of approximately 25 miles. Hard drawn 000 s.w.g. grooved copper wire is used on the straight and cadmium copper of the same gauge is used for the curves; previously most of the wire was of round section.

Preparatory to commencing the track work, portable structures such as office, blacksmith's shop, lamp room, etc., had to be constructed, following on the ordering of plant, tools and material. Although most of the plant and tools are of Australian manufacture it was necessary to import some of the major items.

The gang in each city consists of approximately 60 men, or a total average of 120 men, most of whom had little or no experience at this particular work. A foreman in each city is responsible for the work of his gang, and he in turn is responsible to his engineer, Mr. Morton A. Thomas, who operates between Ballarat and Bendigo. The work has progressed satisfactorily and is nearing completion in Bendigo, but it will probably be about the middle of next year before it is completed in Ballarat.

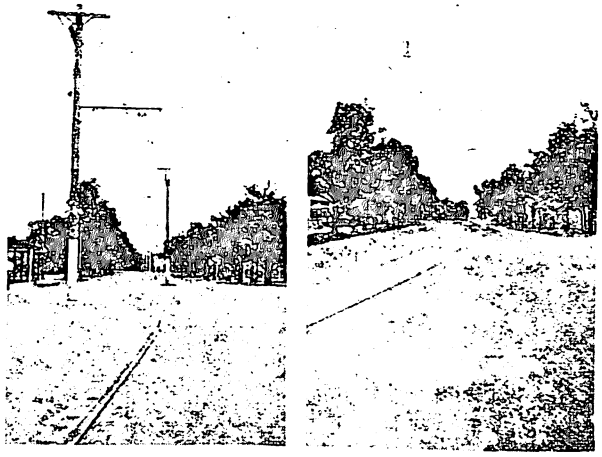


Fig. 4. Line in High Street, Bendigo, Before and After Reconstruction

Reference has been made to the damage caused to the foundations by rail corrugations, and Fig. 1a gives a very good indication of the conditions which obtained throughout both Ballarat and Bendigo. To guard against similar damage to the newly constructed work, the rails have been ground smooth and made free of the high spots (Fig. 1b), but while the work is progressing the pounding set up from this cause is used as much as possible in the early stages to consolidate the foundation. It will be readily understood that, owing to the obstructions, a roller cannot be used for this purpose, but the rail grinding is always completed before the surface work is finished.

In Bendigo a tram water tank, originally used for track cleaning purposes and in Ballarat an old tram with water tank installed are used in the process of scrubbing the rails. Carborundum blocks 12 in. by 3 in. by 2 in. are used as the abrasive agent. Some of the hollows were 40 mils. deep with a pitch of 2½ in. to 5 in. A special frame bolted to the truck is employed to carry these grinding blocks, which are held in tension against the rails by spiral springs. The blocks may be raised or lowered by the driver from inside the tram by means of a screw. The vehicle is driven in either direction and, by means of a two-way tap, the water is supplied to the front end of the blocks according to the direction in which the tram is travelling. An average of about 100 ft. of single track rails are ground during the shift of eight hours.

The nature of the foundations in Bendigo gave little cause for concern, but in Ballarat where much yellow clay exists, it was decided, on the advice of Mr. Finch, city engineer, to use crushed rock as a seal for the clay. Provision has been made for draining off seepage water by laying 4 in. diameter agricultural pipes at the lowest point of the excavation and midway between the rails, outlet pipes being provided at convenient places. The bed for the pipes consists of sieved ashes with a covering of clean mining gravel or coarse ashes. The depth of crushed rock is 6½ in. in the centre and 5 in. at the sides of the excavation, and on this is a layer of graded metal blinded with crushed rock. Sleepers 7 ft. by 8 in. by 4 in. are placed at 2 ft. 6 in. centres, and each rail joint is directly over a sleeper and resting on a ½ in. sole plate. The broken-up concrete stringer and old road metal are used to fill in between the sleepers, and from the sleepers to within approximately ½ in. of the surface mixed metal from 2 in. to ¾ in. is used and penetrated with bitumen after having been well rolled. The surface is then sealed with bitumen and screenings and finished off with a thorough rolling.

Rails are laid to the standard (4 ft. 8½ in.) gauge, and approximately a third of the total have had to be replaced with new ones which are of B.H.P. 801 section with the necessary guard plates. Where B.H.P. rails link up to the grooved rails special joggle fish plates (Fig. 2) have been used, and these, as well as the sole plates, are electrically welded to the rails. The joints, as previously indicated, rest on the sleepers so as to make the former as firm as possible. Hammered rail ends are electrically built up and then ground smooth with a 6-in. electrically-driven emery wheel (Fig. 3), the 60-volt motor obtaining its power supply from the generator of the welding set. The final smoothing of the joints is effected by means of the carborundum blocks attached to the scrubber car, grinding by the rotary hand-operated wheel being insufficient to attain the desired smoothness and freedom from all traces of hollows. The metal is pneumatically packed under the sleepers.

The work is being carried out under the direction of Mr. G. G. Jobbins, M.I.E.E., M.I.E.(Aust.), engineer and manager of the electricity supply and tramways department of the State Electricity Commission of Victoria, and associated with him is Mr. Meakin, A.M.I.E.(Aust.), branch manager at Geelong. The splendid co-operation on the part of the councils concerned and their officers, particularly the engineers, is greatly appreciated by the Commission.

Although at the time the Electricity Commission undertook the responsibility of the tramways the systems were not in good order, they were at their inception a source of pride to the people of Ballarat and Bendigo. Upon completion of the present work, the systems, although lacking some of the expensive refinements of large undertakings, will certainly be considerably modernised to the satisfaction and benefit of the citizens of to-day.

●

Hollow Conductors for Boulder H.T. Transmission

Construction of the Boulder dam on the Colorado river in the United States of America has been completed, and work is now in progress on the generating plant that will develop power at the dam for distribution over a wide area. The city of Los Angeles will be served from this plant by two parallel transmission lines 271 miles in length, which will carry the base load for a city of 1,250,000 people, up to 120,000 kw. per line, at the record high pressure of 287,000 volts.

The conductor for this remarkable service is itself remarkable. As the factor of corona loss required a diameter of 1.4 in., and the current capacity a cross section of 500,000 circular mils, the cable is formed hollow. It is actually a copper tube of strong but flexible segmental construction, entirely without internal support, and weighs only 1.57 lb. per foot. It is formed of flat copper strips with a tongue on one side and a groove on the other, twisted together and tightly locked into a cylinder by the tongues and grooves.*

In addition to having only about one-third of the weight of a normal twisted conductor of similar diameter, this conductor has remarkably low corona loss, owing to its smooth surface. In addition it has unusual characteristics of stability and resistance to dangerous vibration in wind. Approximately 1,650 miles of this cable is required for the line, and it has been manufactured by the General Cable Corporation at Los Angeles.

*See article by Clement Blazey, "Electrical Engineer and Merchandiser," Sept., 1934.